SECTION 15930
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Description of system:
   1. Air terminal units.

B. Work furnished but not installed:
   1. Space thermostats and sensors.

C. Definitions:
   1. Low pressure ductwork: 2500 FPM velocity or less and 2IN WG static pressure or less.
   2. High pressure ductwork: Over 2500 FPM velocity and over 2 IN WG static pressure.

1.2 QUALITY ASSURANCE

A. Design and installation standards:
   1. ASHRAE Guide and Data Book - Equipment, current chapter on duct construction.
   2. Air Diffusion Council, ADC Standard 1062R2, Air Diffusing Equipment Test Code.
   3. Air Moving and Conditioning Association, AMCA Standard 210, Test Code for Air Moving Devices.
   4. ASHRAE Standard 70-72, Method of Testing for Rating the air flow performance of outlets and inlets.
   5. NFPA-90A, Standard for the Installation of Air Conditioning and Ventilating Systems, current edition.
   6. SMACNA HVAC Duct Construction Standard - Metal and Flexible, First Edition, 1985.
   7. UL Publication No.181, Erosion Test Methods.

1.3 SUBMITTALS

A. Product data:
   1. Terminal units.

B. Contract closeout information:
   1. Operating and maintenance data.
   2. Government instruction report.

PART 2 - PRODUCTS

2.1 MATERIALS - GENERAL

A. Acceptable manufacturers:
   1. Air terminal units:
      a. Base:
         1) Titus.
      b. Optional:
         1) Anemostat Air Products.
         2) Tuttle and Bailey.
         3) Krueger.
   2. Other manufacturers desiring approval comply with Document 00440.

2.2 AIR TERMINAL UNITS

A. Air terminal units - general: Factory assembled.

1. Capacity: As indicated.
2. Sound attenuation: Noise produced 3 FT from room outlet not greater than indicated, based on weight scale of A.
3. Noise level: As indicated and not to exceed base manufacturer's noise data at specified conditions.
4. Controllers and operators:
   a. Factory installed on units.
5. Acoustical fiberglass liner:
   a. Comply with NFPA-90A for fire resistivity and UL Standard 181 for erosion.
   b. Insulation shall consist of 1 IN thick non-porous, foil faced rigid fiberglass insulation secured by full length galvanized steel Z-strips which enclose and seal all edges, eliminating tape and adhesives.
6. Provide multi-point velocity pressure sensors with external pressure taps. All air terminal units shall be configured for pressure independent control.
7. Valve adjustment: Field adjustable.
8. Set air terminal units to air flow rates indicated.
9. Casing leakage: 5 percent, maximum, of nominal rated capacity at 3.0 IN WG internal pressure.

B. Electric reheat coils.
   1. Supplied and installed on the terminal by the terminal manufacturer.
      a. UL listed.
      b. Housed in an attenuator section integral with the terminal with element grid recessed from the unit discharge to prevent damage to elements during shipping and installation.
      c. Elements shall be derated nickel chrome, supported by ceramic isolators a minimum of 3.5” apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step.
      d. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety devices.
   2. Provide the following factory mounted accessories:
      a. Primary automatic reset thermal cutout.
      b. Secondary replaceable heat limiter per element.
      c. Differential pressure airflow switch for proof of flow.
      d. Line power terminal block.
      e. Line fusing.
      f. Integral door lock type disconnect switch which will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable
      g. Mercury control contactor for each stage mounted and wired within the control enclosure.
   3. All individual components shall be UL listed or recognized.

C. Inlet air valves for air terminal units: Corrosion resistant, self-seating type.
   1. Frame, links and levers may be of zinc coated steel or aluminum.
   2. Vanes, pivots, hinged or knuckle joints: Aluminum or other non-ferrous metal.
   3. Leakage: Not greater than 3 percent of maximum rated capacity when closed against inlet static pressure of 4.0 IN WG.
   4. Equip with suitable linkage and motor mounting platform to accommodate control operators.
   5. Use resilient sealing members to prevent leakage.
   6. Provide direct reading air flow rate scale and external adjustment.

D. Digital Controls.

1. Each VAV terminal shall include factory furnished application specific controls with integral microelectronic flow sensors mounted within a NEMA 1 enclosure. The controllers shall have been connected by suitable tubing to a multi-point inlet velocity sensor with center averaging, mounted in the inlet to the terminal. An individual transformer shall be furnished on each VAV terminal to provide power for the controller and the contactors for the fan and electric heaters at 24 Vac at 50/60 Hz.
2. Each controller shall be wired, calibrated, and tested by the terminal manufacturer at the factory prior to shipment, with communications address, sequence, and maximum/minimum flow limits factory set in accordance with these specifications and drawings.
3. Suitable bi-directional 24 volt synchronous electric damper actuators shall be supplied and installed at the factory by the manufacturer of the terminal units. The motors shall have heavy duty gears and shall contain a magnetic clutch which releases when the damper is driven to either extreme. Stall type actuators or DC actuators without current limiting are not acceptable.
4. The controllers shall modulate the damper motors to maintain cfm from each terminal in accordance with the cooling/heating requirements calculated by comparing the sensed space temperature with the setpoint and time of day schedule. Zone temperature shall be controlled to +1 degF. Airflow shall be controlled down to 250 fpm, and shall be read in 25 fpm increments at velocities greater than 500 fpm.
5. Setpoints, flow limits, and occupancy schedules shall be maintained indefinitely in each controller's nonvolatile memory. No batteries shall be required. Each controller shall also maintain in its own nonvolatile memory a record of space temperature and/or airflow for the preceding 24 hours.
6. It shall be possible to monitor flow in cfm and to adjust flow limits, temperature setpoints, and schedules without access to the VAV terminal by plugging in a standard IBM compatible laptop computer at the temperature sensor.
7. Each controller shall have an internal software clock to implement setpoint changes and changes of control state, in accordance with the resident occupancy. The clocks will be synchronized hourly and automatically following power failures, by a battery backed real-time clock located in the system interface.
8. Integral to each controller shall be six control states: Occupied, Unoccupied, Night Setback, Morning Warm-Up, Emergency 1, and Emergency 2. Occupied, Unoccupied, and Night Setback states shall have independent heating and cooling temperature setpoints associated with that state, integral to each controller. Controllers shall be able to change states with and without communications to the Building Management System.
9. Each controller shall control zone temperature by varying the airflow into the space using a PI control loop with programmable proportional and integral coefficients. Applications requiring supplemental heat shall utilize a separate PI algorithm, with programmable proportional and integral coefficients to maintain heating temperature setpoint.
10. Temperature sensors suitable for wall or column mounting shall be furnished by the terminal manufacturer for installation by the contractor. Sensor shall be supplied with a vertical base for mounting on a standard 2 IN x 4 IN junction box supplied by the installing contractor (sensor shall include push button for override of Night Setback). Provide external temperature setpoint adjustment.
11. Wiring between controllers and temperature sensors shall be installed using UL listed plenum rated cable conforming to UL 910 (NFPA 262) and factory fitted with suitable modular connectors to match the receptacle on the controllers and temperature sensor. The wiring shall be provided by the manufacturer of the terminal units and shall be tested by the installing contractor.
12. The communication between controllers shall be in accordance with the RS485 Standard at not less than 9600 baud. The protocol shall conform to IEEE 802.3 and requirements of BACnet, and shall be published to facilitate interconnection to the current or a future Building Management System (BMS). The successful operation of the VAV control system shall not depend on the BMS.

13. Commands to change state, modify setpoints, or set operating parameters shall be done on an individual, group, or global basis. Modified values shall be retained in the nonvolatile memory of the DDC terminal controls.
14. When the installation is complete, the installer shall provide a printout showing satisfactory communication with all the terminals and a record of setpoints and minimum and maximum airflow limits of each terminal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units as indicated and in accordance with manufacturer's recommendations and instructions and as specified.

END OF SECTION